Immediate Fixed Restoration of Implants in the Atrophic Edentulous Maxilla

Authored by Joseph A. Toljanic, DDS, Andreas Thor, DDS, PhD, Russell Baer, DDS and Karl Ekstrand, DDS, MS

Upon successful completion of this CE activity 1 CE credit hour may be awarded.
Immediate Fixed Restoration of Implants in the Atrophic Edentulous Maxilla

LEARNING OBJECTIVES:

After reading this article, the individual will learn:

- a clinical technique for implant placement and immediate fixed provisional restoration of the atrophic edentulous maxilla, and
- early outcomes for the presented protocol.

ABOUT THE AUTHORS

**Dr. Toljanic** is a board-certified prosthodontist at the University of Chicago, where he is a full professor and co-chief of dentistry. He also maintains a part-time practice with a focus on implant rehabilitation. He can be reached at (773) 702-9873 or jtoljani@surgery.bsd.uchicago.edu.

**Disclosure:** Astra Tech funds ongoing research from which data were drawn and included in this article.

**Dr. Thor** is a maxillofacial surgeon at Uppsala University Hospital, Uppsala, Sweden. His research focus is on biomaterials, bone reconstruction, and dental implants. He can be reached at 46 (0) 18-611-6450 or andreas.thor@lul.se.

**Disclosure:** This research is supported by a grant from Astra Tech. The data reported here were presented at the 16th annual meeting of the European Academy of Osseointegration, Barcelona, Spain, in October 2007.

**Dr. Baer** is a clinical associate at the University of Chicago. He maintains a private practice with a focus on implant rehabilitation. He can be reached at (773) 702-6812 or rabaer@midway.uchicago.edu.

**Disclosure:** Dr. Baer is an investigator in clinical research partially funded by Astra Zenica.

**Dr. Ekstrand** is a board-certified prosthodontist at the University of Oslo, where he is the director of Postgraduate Education in Prosthodontics. He can be reached at 46-70-593-1199 or karl.ekstrand@odont.uio.no.

**Disclosure:** This research is partially supported by grants from Astra Zenica.

INTRODUCTION

With more than 40 years of clinical use, endosseous dental implants are recognized as one of the safest and most predictable options for tooth replacement. Implants are now routinely used to replace teeth in edentulous segments ranging from a single tooth to a fully edentulous jaw, providing patients with both functional and aesthetic outcomes that can approximate the natural dentition. Long-term outcomes also indicate survival rates of better than 90% after 5 years (Table 1).

Patient expectations for implant rehabilitation have now moved beyond demands for safety and function to include aesthetics and ease of treatment, including shorter treatment times. In response to these demands, a large body of evidence has been generated over the past 10 years supporting the use of immediate fixed provisional restoration of dental implants in a wide variety of clinical situations.1-6 Combining implant placement with immediate provisionalization meets patient expectations by providing a restoration on the day of implant surgery. Further, the

<table>
<thead>
<tr>
<th>Lead author</th>
<th>Number of patients placed</th>
<th>Implants placed</th>
<th>Follow-up interval</th>
<th>Implant survival %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ostman5</td>
<td>20</td>
<td>123</td>
<td>1 year</td>
<td>99.2</td>
</tr>
<tr>
<td>Tarnow6</td>
<td>4</td>
<td>34</td>
<td>1 to 3 years</td>
<td>100.0</td>
</tr>
<tr>
<td>Jaffin7</td>
<td>34</td>
<td>236</td>
<td>up to 5 years</td>
<td>93.0</td>
</tr>
<tr>
<td>van Steenberghe8</td>
<td>27</td>
<td>184</td>
<td>up to 1 year</td>
<td>100.0</td>
</tr>
<tr>
<td>Malo9</td>
<td>32</td>
<td>128</td>
<td>1 year</td>
<td>97.6</td>
</tr>
<tr>
<td>Capelli10</td>
<td>41</td>
<td>246</td>
<td>up to 3 years</td>
<td>97.6</td>
</tr>
</tbody>
</table>
restoration looks and feels more natural and comfortable as compared to traditional temporary removable prostheses. The provisional fixed restoration also guides peri-implant soft-tissue healing, creating a more natural tissue contour and a better aesthetic outcome. The outcomes of implant rehabilitation protocols that include immediate provisional restoration approach those with delayed restoration in many clinical applications. In the authors’ experience, patients typically respond most favorably to immediate provisionalization. Patients frequently comment that an immediate fixed provisional restoration has improved their overall sense of satisfaction with the treatment, and they indicate that this aspect of care is one reason for selecting a treatment plan that includes implant rehabilitation.

However, limited data are available on clinical outcomes of immediate provisional restoration of implants to restore the edentulous maxilla (Table 1). Following tooth extraction, the maxilla commonly exhibits marked alveolar bone resorption, resulting in a significant loss of bone volume and density. This may limit the availability of sites for implant placement and reduce the ability to achieve adequate primary implant stability. Provisional restoration of implants lacking adequate primary stability may result in excessive implant micromotion during healing, leading to a failure of the implant to integrate. While bone augmentation grafting of the maxilla remains an option for increasing alveolar bone volume, the additional treatment time and cost does not meet the demands of many patients.

Additional data regarding implant treatment outcomes for the edentulous maxilla are warranted in order to better understand the range of patient care options. Clinicians use these data to guide their patients in making informed treatment decisions. This article reviews preliminary findings from an ongoing clinical trial designed to assess the efficacy of immediate restoration of implants placed into an edentulous atrophic maxilla. Bone augmentation was not part of the surgical procedure.

**STUDY DESIGN**

Individuals were eligible for enrollment if they were healthy adults with an atrophic edentulous maxilla and did not use tobacco products. The investigators determined maxillary atrophy using a classification system designed to score (1) alveolar bone quantity on a scale from type A bone (minimal alveolar bone resorption) through type E bone (extreme alveolar bone resorption), and (2) bone quality on a scale from type 1 bone (mostly compact bone) through type 4 bone (mostly trabecular bone). Scores were assigned based on clinical and radiographic examination, with subjects identified as eligible for enrollment with bone quantity scores of C, D, or E and bone quality scores of 3 or 4 (at the proposed sites of implant placement). As bone grafting was not part of the study protocol, sufficient existing bone volume was then required for implant placement. Bone volume was assessed clinically by visual inspection, palpation, and radiographically with panoramic imaging. The smallest implant used in this study...
was 3.5 mm in diameter and 8 mm in length. Based on these criteria, 51 subjects were enrolled and underwent treatment at 2 participating clinical centers. Informed written consent was obtained from all subjects following approved institutional review board guidelines.

Data acquired during this study include bone quantity and quality scores at the site of implant placement, the size of the implants used, and implant location. Periapical radiographs were obtained at the time of implant placement, placement of the definitive restoration, and at each follow-up visit in order to assess crestal bone height over time. Finally, the level of primary stability achieved for each implant at the time of placement was obtained, measured in Ncm of force required to seat the implant fully using a calibrated torque wrench (Torque-Lock Wrench [Intra-Lock International]). Follow-up occurred at 6 and 12 months after placement of the implants and restorations, and then annually for a total follow-up period of 5 years.

IMPLANT SURGERY

All subjects received 6 implants in the maxilla. The implants selected for use were threaded, self-tapping titanium implants with micro-threads in the collar region (Os-seoSpeed [Astra Tech]). These implants have a titanium oxide, blast-roughened surface further modified by the inclusion of fluoride ions during the manufacturing process.

Implant placement surgery was performed under infiltration local anesthesia using a standard soft-tissue flap design. Each osteotomy was initiated by introducing a pilot drill to the site. Care was then taken during enlargement of the osteotomy sites to account for the lack of bone density and volume that was commonly encountered. This frequently led to underpreparation of the osteotomy site diameter relative to the implant diameter that was planned for insertion, with reliance on the self-tapping design of the implant to laterally compress the bony walls during seating to maximize primary stability (Figure 1). In addition, the posterior implants were commonly placed with a distal angulation, positioning them immediately adjacent to the anterior wall of the maxillary sinus (Figures 2 and 3). This permitted the use of longer implants to engage more bone, while also creating a posterior shift of the implant platform to better support the provisional restoration while minimizing posterior cantilevers. Transmucosal abutments were screwed into place (Figure 4). Straight or angled transmucosal abutments were chosen in order to correct for implant placement angulation and to prevent unaesthetic outcomes arising from screw access holes exiting through the facial surfaces of the teeth. Six copings were cut to the

Figure 3. Periapical radiograph showing distal angulation of the posterior implant in close proximity to the anterior wall of the maxillary sinus.

Figure 4. Interoperative placement of transmucosal implant abutment cylinders.

Figure 5. Retentive coping cylinders custom shaped prior to screwing onto the transmucosal abutments.
desired size for each subject (Figure 5). These copings were screwed onto the transmucosal abutments. Finally, the flaps were sutured closed around the transmucosal abutments/retentive copings (Figure 6).

**IMMEDIATE PROVISIONAL RESTORATION**

Fabrication of the provisional screw-retained fixed restoration commenced immediately after implant placement. The subjects’ existing complete maxillary dentures were used to fabricate the provisional fixed restoration. When the occlusion or vertical dimension were incorrect in the existing denture, a new removable complete denture was fabricated prior to treatment. On the day of implant placement, holes were drilled into the prosthesis corresponding to the 6 retentive copings (Figure 7). The holes were of sufficient diameter to allow easy visualization of the copings (Figure 8). An autopolymerizing resin was then painted around each of the retentive copings to lute them onto the denture prosthesis (Figure 9). As the resin was polymerizing, the subject was periodically asked to open and close in order to ensure maintenance of the pre-established vertical dimension and proper occlusal contacts.

Following resin polymerization, all 6 copings were unscrewed, and the prosthesis was removed from the mouth with the copings luted to the prosthesis (Figure 10). Any voids noted between the copings and the prosthesis were then filled with additional resin. The palate and flanges of the prosthesis were removed. Glass fiber reinforcement was then placed into a trough cut in the exterior lingual surface of the prosthesis to increase fracture resistance (EverStick C & B fiber reinforcement [Preat]; Figure 11).

The resultant fixed provisional restoration was finished, polished, and then screwed back onto the implant abutments (Figure 12). Centric occlusion was assessed, and excessive contacts were reduced to create even bilateral contact. Aesthetics was assessed and revised as needed with input from the patient (Figure 13). Periapical radiographs were obtained of all implant sites to confirm fit of the restoration onto the implants and to establish baseline crestal bone height data. Finally, the screw holes were covered with a temporary restorative material (Fermit [Ivoclar Vivadent]).
An alternative restorative procedure included making impressions immediately after implant placement and pouring a master cast. A screw-retained provisional fixed restoration was then fabricated in the laboratory on this cast using all of the steps outlined above. Under these circumstances, the restoration was delivered within 24 hours of implant placement.

Postsurgical management for all subjects included prescribing systemic antibiotics (generic amoxicillin 500 mg QID x 7 days or generic clindamycin 150 mg TID x 7 days for penicillin-allergic subjects), a topical antimicrobial rinse (chlor-hexidine gluconate 0.12% to be used on an ongoing basis), and oral analgesics (ibuprofen 600 mg TID x 3 days to be continued as needed for pain control, with narcotic-based analgesics as needed for pain control). Subjects were instructed to maintain a soft diet for 6 weeks. Hygiene instructions included gentle brushing of the treated area for the first 4 weeks, followed by normal brushing and flossing. Subjects returned after 2 and 4 weeks for follow-up examinations. Healing of the surgical sites and function of the fixed provisional restoration were assessed at these visits. Subjects were then scheduled to return at 12 weeks for further study follow-up and to commence fabrication of definitive fixed restorations.

**EARLY STUDY OUTCOMES**

Fifty-one subjects underwent study treatment; 50 subjects with a total of 300 implants returned 12 weeks after treatment (one subject was lost to follow-up). At this visit, the fixed provisional restorations were evaluated. The restorations were then unscrewed, and all implants were clinically and radiographically examined to determine integration outcomes prior to commencing fabrication of the definitive fixed restoration (Figure 14). It was determined that 288 of the 300 implants were judged clinically to be integrated and ready for definitive restorative treatment. Periapical radiographs taken at this time interval demonstrated close apposition of bone at the implant surface without evidence of interfacial radiolucencies (Figures 15 and 16). This represents an early implant survival rate of 96%. Twelve implants in 5 subjects were noted to be nonintegrated, requiring removal. Forty-seven
of 50 fixed provisional restorations placed were found to have remained in function throughout the 12-week follow-up period, representing a provisional prosthesis success rate of 94%. These 47 subjects subsequently underwent successful definitive fixed restorative treatment. Of the 12 implants that were not judged clinically to be integrated, 2 implants were subsequently replaced in 2 subjects (one implant per subject) without interrupting the wearing of the immediate provisional restoration or the subsequent fabrication of the definitive fixed restoration. The remaining 3 subjects experienced a total of 10 implant failures requiring removal of the fixed restoration without follow-up implant placement (Table 2). These subjects were subsequently restored with a removable denture and were not continued in the study.

DISCUSSION

Restoration of the edentulous maxilla with implants can present significant challenges for the clinician. Marked loss of bone volume and density is a limiting factor for placement of a sufficient number of implants, located in strategic positions, to allow fabrication of a fixed restoration. The bone loss further impedes obtaining primary implant stability, which is important for immediate provisional restoration. Among the challenges in clinical implantology is identification of approaches to treat the patient with an atrophic maxilla. The protocol under investigation is aimed at determining the efficacy of an approach that accomplishes that goal without the need for bone augmentation, which often presents problems for patients in terms of discomfort, extended treatment time, and added expense. The protocol described above will continue to observe patients for a total of 5 years to assess the long-term efficacy of treatment.

CONCLUSION

Limited data are currently available describing implant rehabilitation outcomes that include immediate provisional restoration of the edentulous maxilla. Early results obtained from this study suggest that implant integration can be predictably achieved when combined with immediate fixed provisional restoration, without the use of bone grafting in the atrophic edentulous maxilla. This protocol has distinct advantages, but longer follow-up is needed before the described approach is recommended as a treatment option.
Immediate Fixed Restoration of Implants in the Atrophic Edentulous Maxilla

REFERENCES


Immediate Fixed Restoration of Implants in the Atrophic Edentulous Maxilla

POST EXAMINATION INFORMATION

To receive continuing education credit for participation in this educational activity you must complete the program post examination and receive a score of 70% or better.

Traditional Completion Option:
You may fax or mail your answers with payment to Dentistry Today (see Traditional Completion Information on following page). All information requested must be provided in order to process the program for credit. Be sure to complete your “Payment”, “Personal Certification Information”, “Answers” and “Evaluation” forms, Your exam will be graded within 72 hours of receipt. Upon successful completion of the post-exam (70% or higher), a “letter of completion” will be mailed to the address provided.

Online Completion Option:
Use this page to review the questions and mark your answers. Return to dentalCEtoday.com and sign in. If you have not previously purchased the program select it from the “Online Courses” listing and complete the online purchase process. Once purchased the program will be added to your User History page where a Take Exam link will be provided directly across from the program title. Select the Take Exam link, complete all the program questions and Submit your answers. An immediate grade report will be provided. Upon receiving a passing grade complete the online evaluation form. Upon submitting the form your Letter Of Completion will be provided immediately for printing.

General Program Information:
Online users may login to dentalCEtoday.com anytime in the future to access previously purchased programs and view or print “letters of completion” and results.

POST EXAMINATION QUESTIONS

1. Implant placement with immediate provisionalization in the atrophic edentulous maxilla poses clinical challenges due to ____.
   a. post-extraction increase in bone density that impedes osteotomy preparation
   b. marked decrease in bone volume/density post-extraction
   c. lack of micromotion following implant placement
   d. inability to perform sinus lift bone grafting

2. Osteotomy preparation for the atrophic maxilla prior to immediate provisional restoration should include ____.
   a. underpreparation relative to implant diameter to maximize primary stability
   b. guide pins to ensure parallel placement of implants
   c. preparation to minimize lateral compression of bony walls during implant insertion
   d. mesial inclination of posterior implants to permit longer implants that engage more bone

3. Using a previously worn removable complete denture prosthesis for fabricating the immediate fixed provisional restoration ____.
   a. is not recommended for the atrophic edentulous maxilla
   b. maintains the current occlusal contacts and vertical dimension
   c. is indicated only when planning a removable provisional
   d. limits the ability to achieve an aesthetic final result

4. An alternative to direct fabrication of the immediate fixed provisional restoration is ____.
   a. delaying restoration for 3 weeks to allow adequate soft-tissue healing
   b. fabrication of an attachment retained removable overdenture
   c. a pre-implant surgery impression to process unsplinted, single-unit fixed provisional crowns
   d. immediate post-implant surgery impression for a fixed provisional restoration delivered within 24 hours of surgery

5. After immediate fixed provisional restoration of implants, gentle brushing of the treatment area ____.
   a. can commence immediately
   b. can commence in 2 weeks
   c. can commence in 4 weeks
   d. can commence in 8 weeks

6. Definitive fixed restoration of the atrophic edentulous maxilla following implantation/immediate provisionalization ____.
   a. can commence in 4 weeks
   b. can commence in 8 weeks
   c. can commence in 12 weeks
   d. can commence in 6 months

7. The following system is used to score alveolar bone quantity:
   a. Type 1 indicates minimal alveolar bone resorption.
   b. Type A indicates minimal alveolar bone resorption.
   c. Type E indicates mostly trabecular bone.
   d. Type 4 indicates mostly compact bone.

8. Placing posterior implants with a distal angulation and immediately adjacent to the anterior wall of the maxillary sinus ____.
   a. permits use of shorter implants
   b. permits use of longer implants
   c. results in the implants engaging less bone
   d. creates an anterior shift of the implant platform
**PROGRAM COMPLETION INFORMATION**

If you wish to purchase and complete this activity traditionally (mail or fax) rather than Online, you must provide the information requested below. Please be sure to select your answers carefully and complete the evaluation information. To receive credit you must answer at least six of the eight questions correctly.

*Complete online at:*  www.dentalcetoday.com

**TRADITIONAL COMPLETION INFORMATION:**

Mail or Fax this completed form with payment to:

**Dentistry Today**

*Department of Continuing Education*

*100 Passaic Avenue*

*Fairfield, NJ 07004*

*Fax: 973-882-3662*

**PAYMENT & CREDIT INFORMATION:**

**Examination Fee:** $20.00  **Credit Hours:** 1.0

Note: There is a $10 surcharge to process a check drawn on any bank other than a US bank. Should you have additional questions, please contact us at (973) 882-4700.

- I have enclosed a check or money order.
- I am using a credit card.

My Credit Card information is provided below.

- American Express  
- Visa  
- MC  
- Discover

Please provide the following (please print clearly):

**PROGRAM EVALUATION FORM**

Please complete the following activity evaluation questions.

**Rating Scale:** Excellent = 5 and Poor = 0

1. a b c d  5. a b c d
2. a b c d  6. a b c d
3. a b c d  7. a b c d
4. a b c d  8. a b c d

**PERSONAL CERTIFICATION INFORMATION:**

<table>
<thead>
<tr>
<th>Last Name (PLEASE PRINT CLEARLY OR TYPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name</td>
</tr>
<tr>
<td>Profession / Credentials</td>
</tr>
<tr>
<td>License Number</td>
</tr>
<tr>
<td>Street Address</td>
</tr>
<tr>
<td>Suite or Apartment Number</td>
</tr>
<tr>
<td>City</td>
</tr>
<tr>
<td>State</td>
</tr>
<tr>
<td>Zip Code</td>
</tr>
<tr>
<td>Daytime Telephone Number With Area Code</td>
</tr>
<tr>
<td>Fax Number With Area Code</td>
</tr>
<tr>
<td>E-mail Address</td>
</tr>
</tbody>
</table>

**ANSWER FORM: COURSE #: 102.2**

Please check the correct box for each question below.

Please provide the following (please print clearly):

- Exact Name on Credit Card
- Credit Card #  
- Expiration Date

Signature

---

*Dentistry Today is an ADA CERP Recognized Provider.*

*Approved PACE Program Provider FAGD/MAGD Credit Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. June 1, 2006 to May 31, 2009*  

**AGD PACE approval number:** 309062